Track without launching

A white paper in response to LETSI's call – summer 2008

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1. Abstract

This white paper is written in response to LETSI's solicitation of white papers concerning the technical and pedagogical requirements for future learning systems interoperability issued May 2008.

It describes the need for a way for learning content to be able to pass tracking information to a management system without the learning content necessarily having been launched by the management system. This would be useful both as a more robust mechanism for tracking results when learning content is called from a management system and as a way for tracking learning content without a management system having to launch it.

The proposed solution is a web service to pass results from learning content to a management system.

2. Problem definition

2.1 Existing launch and track

The following terms are used in this white paper

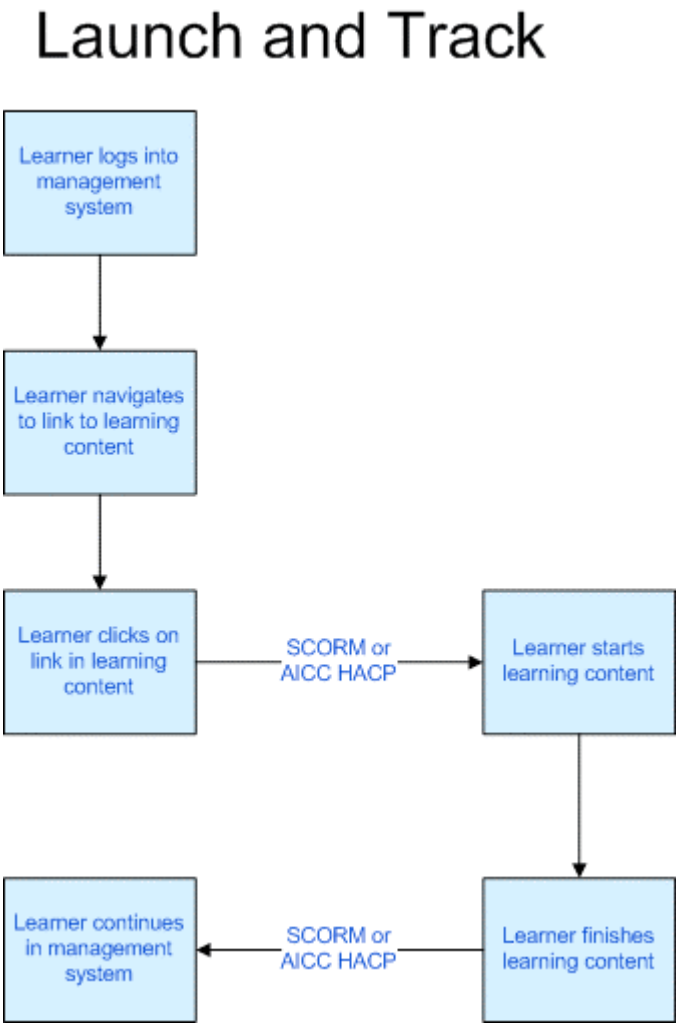
- "Management system" is used to refer to a generic management system which might be a learning management system (LMS), assessment management system (AMS),course management system (CMS), talent management system or other.
- "Learning content" is used to refer to general learning content, which might be teaching material, an exercise, a simulation, an assessment or other kinds of learning content
- "Learner" is used for the person undertaking the learning, also known as participant, candidate, student.

The main way that current learning technology standards permit two learning programs to interact are via the SCORM (1.2 and 2004) and AICC HACP standards.

In both SCORM and AICC HACP, the interaction works as follows

(1) The learner logs into the management system in a web browser
(2) The management system launches the learner into some learning content
(3) The learner engages in the learning content
(4) The learning content reports completion and/or results to the management system. In SCORM this happens by browser to browser communication; in AICC HACP this happens server to server.

This is commonly called “Launch and track”. The management system launches the learning content and receives back data to track progress, as shown in the diagram below.



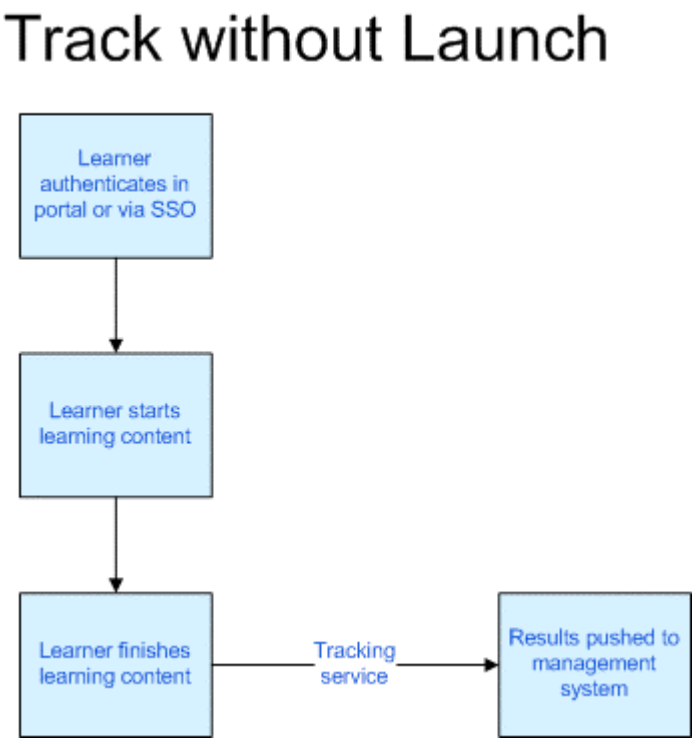
However although launch and track is a very successful method of interoperability, there are many situations where it does not fully work to meet the interoperability needs of users. There are two classes of problems:

2.2 Occasions where launch is not from the management system

There are many scenarios where users or organizations may wish to initiate learning content where the learner is not logged into a management system to start the learning content, but where it would still be desirable to push results of the learning content into the management system.

(a) One such situation is just in time learning, where learning content is included within an application and the learner can ask to engage in the learning at any time during an application. In this situation a learner may get stuck or confused in performing an action and ask for some learning content help. It would be useful for the results of such learning content to be able to be passed back to a management system.
(b) With the increasing advent of portal technology and single sign on technology within many organizations, the need for a learning management system to initiate learning content is reduced, it's possible for a portal for instance to allow a learner to choose some learning content or route to a specialist learning or assessment system without needing the learner to access the content via the management system first.
(c) Some learning content is not online, it may be based on a desktop computer or use simulation technology or be completed on paper and have results scanned in. Such learning content cannot be launched from a web-based management system but could push back results to it.
(d) For summative assessments (exams), there may be a need for specialist authentication measures to be taken (e.g. a proctor confirm identify, or a photo of the learner taken). Such assessments may be started in a specialist assessment system but it may be desirable to return the results to a management system
(e) Some management systems may focus on tracking results only, for instance a standalone gradebook system might hold learning content results but not have any way of launching results. A standard way of returning results to a grade book would be useful.

The diagram below shows the desired behavior in this circumstance



2.3 Occasions where launch is from the management system but tracking needs to be different to that available in current standards

Where learning content is a browser object that runs on the client computer, then the SCORM (1.2 and 2004) concept of a learning content object (SCO) makes sense, and there is little need to return the results except via the calling launch mechanism because the learning content has no meaning outside the browser session that initiated it.

However very often SCORM is used to call learning content that runs from an independent server based system which allows more intelligence in the learning content than a client based system allows. In such cases, the requirement that results must be returned into the browser session that called the learning content is a significant restriction. Even with AICC HACP, which allows server to server communication, there are still occasions where tracking separate to launch would be useful. Some areas where this arises:

(a) Technical failures cause a problem with launch and track. If the browser session fails either because the PC crashes or because the learner closes the browser, it's often not possible to return completion information. Also with launch and track, if the network goes down at the time of tracking, it's not normally possible to return a score. [Questionmark has 100s of customers who use launch and track, using AICC HACP, SCORM and proprietary methods of access to CMSs; and it's a common issue that a small proportion of results don't get through, usually due to

network failure.] A tracking mechanism that is independent to launch would be much more reliable as any failures could easily be retried or held in a queue until the network gets back up.

(b) Where learning content is an assessment and the assessment includes essay questions, which are human graded, it's not possible to return a score until the grading has been completed, which often will be days after the assessment is taken. So it would be very desirable for learning content to report immediately a result which says that the assessment has been completed but that the score is to follow.

(c) There are other occasions when an assessment score is desired not to be reported at once, for instance in medium to higher stakes assessments, it's common for scores of a cohort to be reviewed prior to being released. It's also common not to release scores until the end of a testing window.

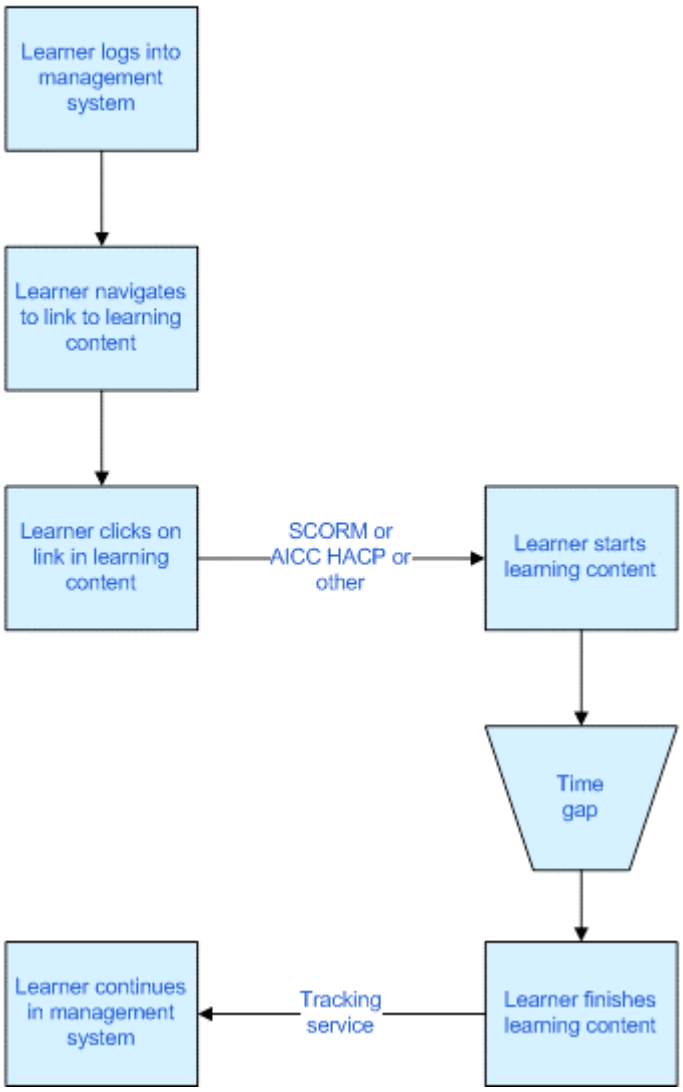
(d) Sometimes learning content may identify that it's desirable to run a second piece of learning content. The strict model in SCORM of SCOs and in AICC of AUs doesn't formally permit this, and requires the management system to call the second piece of learning content. But in reality it can be useful for learning content to be able to directly branch to other learning content , but then to be able to return completion information or a score to the management system.

(e) The launch and track mechanism assumes that the learning content is completed in a short time, but this does not work well when the content might take a long time, for example it is downloaded and taken offline. Here it would be much better if the learning content could be launched from a management system, but then results sent back via a tracking system independent to launch.

(f) Sometimes it might be desirable to send results back to more than one management system, for instance to send results to a course management system and to a university student management system.

In summary, there are many situations where a tracking mechanism would be useful, so that results could be sent to a management system independent to the launch mechanism. The diagram below shows this conceptually.

Launch and Independent Track



3. Use cases

Use cases for the new service are a mirror of the problem statement above, ie:

- Just in time learning, which is launched from an application and returns results to a management system
- Learning or assessment content which is launched from a specialist or independent learning system, authenticated via a central mechanism and has its results returned to a management system
- Desktop or non-computer learning content which can then have results uploaded to a management system

- Exams delivered by independent and highly secure assessment software which wants to push results to a management system
- Management systems that record results but which do not launch content (e.g. gradebooks, student results services)
- Systems that currently use SCORM or AICC HACP launch and track but which would like more reliable results return and cannot afford occasional drops due to technical failures
- Assessment content that includes essays or other human graded questions
- Assessment content that needs review before results are returned or which waits until the end of the testing period
- Learning content that identifies a need to launch a second piece of learning content and which does not wish to return to the management system to call the second piece but due to more local information or for technical reasons finds it simplest to launch it directly but which wants the results returned to a management system
- Learning content that is downloaded and taken over a long period and then results returned
- Environments where there are several management systems all of which need results return

4. Stakeholders

Stakeholders who potentially would be interested in this standard would be

- Learning content vendors who would like the freedom to launch themselves without needing an LMS or CMS to launch, but still need to get results back to the management system
- Management system vendors who are keen to get results back from a wide variety of learning content
- Users of the above systems who will get more interoperability and seamless transition of data

5. Proposed solution

Accordingly this white paper proposes that there needs to be a way of results tracking independent to launch. Learning content needs to be able to send (push) results to a management system when the learning content is complete. The availability of such a results tracking service would allow

- Some learning content will be launched and tracked from a management system. Using SCORM or AICC HACP or updates to these standards
- Some learning content will be launched from a management system but results tracked via a new method
- And some learning content will be independently launched and have results sent by the tracking system

The input parameters to such a service would need to make sense in the context of other SCORM work and the data model would need to be consistent with the data model for any updated SCORM runtime model, but the following would seem to be possible input parameters:

Name	Mandatory?	Meaning
System ID	Y	ID of the system from which results are coming from. Typically a management system might be set up to receive results from certain identified systems and reject input from unidentified systems. The system ID would be set up in advance between the systems.
Learner ID	Y	Unique ID of the learner, standard text. Many management systems would require the learner ID to match a known person and reject the result if the learner ID is not known.
Additional information	N	Additional information on the learner including personal details and organization details. HR-XML have an XML data model for person information when taking assessments that could be considered for this.
Verified	Y	Yes or no as to whether the learner's ID was verified
Verification Data	N	Further information on how the verification was done, a text string that might contain a proctor name or ID references or other text
Location	N	Information on the location of the learning (e.g. training center)
Learning Content ID	Y	ID of the learning content, unique to the pushing system
Learning Content Name	Y	Textual description of the learning content
Outcome	Y	Text description of the outcome, e.g. "Pass", "Fail", "Completed"
% score	N	0-100%
Points score	N	Raw score in points
Min score	N	Minimum score in points, usually 0
Max score	N	Maximum score in points
Session ID	N	Optional session ID that can be used if the content was launched by the management system data is being returned to
Course ID	N	Optional course ID to help a CMS like Moodle or Blackboard identify the course to register the result under.
Start date/time	N	Date and time of learning content being started (in universal time)
Finish date/time	Y	Date and time of learning content being finished (in universal time)
Time taken	N	Time taken to do the learning content

It should be possible to use or adapt the SCORM CMI model for the above information. If for some reason this is not practical, then the HR-XML model for assessment data could be considered.

6. Technical issues

6.1 Web service format

Although other transport methods for tracking might be possible (e.g. some HTTP communication), the obvious method to return tracking data would seem to be a SOAP web service. Web services have proved themselves in the Internet world as being a reliable way to pass data between different systems that work in a variety of computer environments and they are cheap to implement on both sides of the fence.

It's suggested that there is a single, stateless web service with one method called ReturnResults which uses SOAP 1.1 to receive data.

Input parameters are as above.

Output parameters would be:

- Success (yes or no)
- Results ID (ID returned by the management system to allow future reference to the result)
- Errorcode (error if the results cannot be received)

6.2 Security

It's clearly important that this method can provide security since if someone could post results to a management system that were not genuine, this could have undesirable consequences (false data about a person). Due to information passing through a browser, there are some security concerns about the existing SCORM standards (see for instance the paper presented in 2002 to the AICC by Paul Roberts of Questionmark at http://www.aicc.org/docs/meetings/04feb2002/api-security.zip) and it's important that this method provides reasonable security.

It's suggested that three security mechanisms are built into the service

(1) Management systems will be encouraged to only accept input from learning content systems that have been registered with it. This may include requiring the URL or IP address of the system being that expected

(2) One of the parameters in the web service call should be an EXPIRY date/time in UTC, this will prevent calls being cached and re-used later. Since the expiry time will be used within the checksum below, it cannot be altered.

(3) Most importantly, the management system and learning content system should have a shared secret, set when configuring the connection. The learning content system should use the shared secret to construct a checksum of all the web service call parameters when making the call. The management system should check the checksum and only accept the call if it matches. It's suggested that the recommended checksum algorithm uses the SHA-256 algorithm (http://en.wikipedia.org/wiki/SHA-1) which is cryptographically sound.

Depending on potential implementer feedback, it may be sensible to have three levels of security:

- No checksum required, for debugging and for environments where security is not needed
- ASCII addition checksum, for low security
- A full SHA-256 checksum for higher security

6.3 How content knows where to send data

A possible extension to the system might be some standard way of telling content the URL to send results data to. This might be included within a content package in some way.

7. Existing implementations

There are no existing implementations or prototypes of this web service. However this should be a cheap standard to implement for management system and content vendors as it is a simple, single web service call.

8. Summary and recommendations

Launch and track has served the industry well but has several use cases where it would be desirable to track the information separately to the launch. And there are many use cases where it makes more sense to launch independently and then track the data.

A simple web service call is proposed to allow learning content to send completion information to a management system. This would be:

- Simple to implement for a management system
- Simple to implement for a learning content system
- Effective in passing information from one to the other and likely to be widely used

The authors would welcome comments on this proposal and can be contacted via John Kleeman at john@questionmark.com.